A 17th Century Netherlandish Panel Painting

Identification of wood, construction and dendrochronology

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Wood Structure and Applications

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Abstract

The aim of this project is to apply the techniques and acquired information during the course *Wood Structure and Application*, to a 17th century Netherlandish panel painting. This includes identification of species of wood used for both the panel and its frame, the construction of the panel in relation to written sources, and a dendrochronological examination for dating and geographical origin. The panel appeared to be made of oak (*Quercus*), and constructed of radial cut planks joined with sapwood against sapwood, all in god relation to the sources about panel making techniques used in the 16th and 17th century. The wood used for the frame appeared to be alder (*Alnus*) but no further investigations into the practice of its use were performed. The planks of the panel was dated through dendrochronological examination, the upper plank having a felling time *after* 1638 A.D. and the lower plank having a felling time *after* 1654 A.D. This result confirms the era of the execution of the painting but cannot completely conclude that it was painted by the attributed painter Pieter Claesz (c. 1597-1 January 1660).

Forword

This is a project for the course *Wood Structure and Applications* at the University of Copenhagen, held in cooperation between the Department of Forest & Landscape and the Department of Agriculture and Ecology from January 31st – April 8th 2011.

The interest in wood structures and applications has evolved during studies at The Royal Danish Academy of Fine Art, The School of Conservation where I have specialized in conservation and restoration of pictorial art. Wood is often seen as a material in art, either as the support for paintings or polychrome sculpture, as a supportive frame for canvas, or as a decorative frame.

When choosing a project for the course, it felt natural to try and apply the techniques and newly acquired information from the course, to a painting on wood, and use the information in a situation which will be the closest related to instances where I will be using it, in the future of my career.

I would like to thank Jettie van Lanschot for trusting me with her painting and making it available for the examinations performed, and thereby making the aim of this project possible.

I would also like to give a large thanks to Niels Bonde and Orla Hylleberg Eriksen at the laboratory of dendrochronology at the National Museum of Denmark (NNU). Thank you for giving access to your equipment and the use of your time, you have been most helpful and kind.

Contents

1. Introduction

Until the 16th century wood acted as the primary support for paintings. During the 16th and 17th century, a stylistic development took place and canvas became the preferred support for paintings. However, wood as support has been and still is used on a regular basis, and is also used for the inner frame (stretcher/strainer) on which the canvas is stretched upon. In all instances wood has also been used for the decorative outer frame which acts as a container for a painting. Wood and art are therefore closely related. The properties of wood are an important factor, when working with paintings, and it can play an important role in a paintings state of preservation.

The aim of this project is to try and identify the species of wood used for a Netherlandish panel painting, presumably dating from the 17th century, and also to give a description of the construction of the panel. With aid from the National Museum of Denmark, a dendrochronological examination will be performed to hopefully determine the time and geographical placement of the wood, and which could possibly help substantiate the authenticity of the painting.

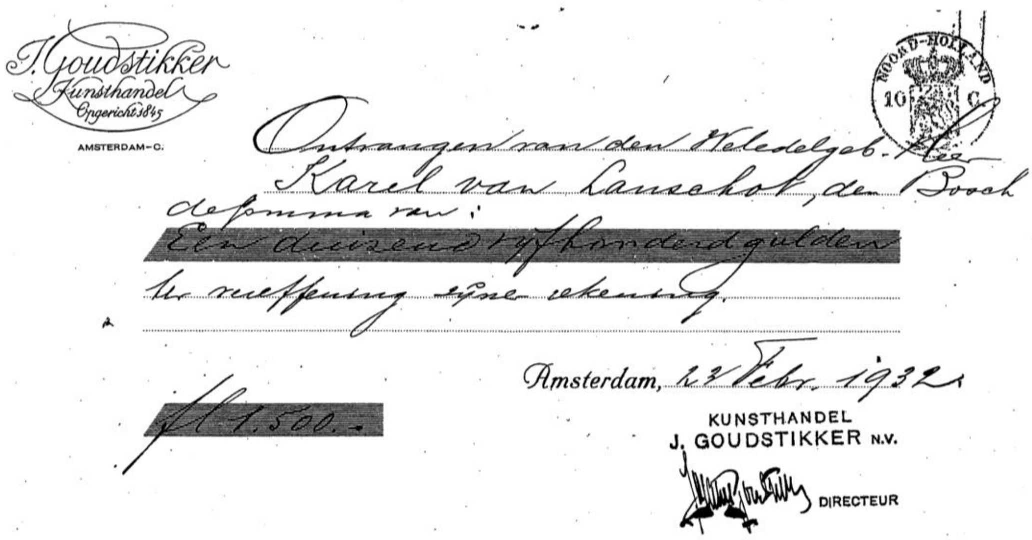
Identification of wood species will be performed both macroscopically and microscopically on both the panel and the frame of the painting, in order to test if it is possible to determine the type of wood which has been used. In general, proper identification of wood can be fundamental to conservation treatment when repair or replacement is involved, or when it is important to anticipate the properties or the behavior of a panel. Both when using wood and canvas as support for painting, it is worth mentioning, that the painting is never (rarely) painted directly on the support. Often first a layer of glue size is added, and then a layer made of e.g. glue and gypsum/chalk, which acts as the ground of the painting. A direct contact between the support and oil paints would cause in fast deterioration. Further details into this subject, as well as the reaction between the layers of the painting, due to changes in relative humidity and temperature, will not be in the focus of this report.

In addition to the aim stated above, the project will give a short introduction to the genre of the painting as well as investigating the construction and the preparation of panel paintings. This will be done in relation to literature on the subject describing the procedure for making panels during the 16th and 17th century.

2. The panel painting, a still-life

The painting used for this project is from Holland and dates presumably from the first half of the 17th century, this due to the painting technique and the paintings subject. The painting is owned by a private person, and was acquired by the owner's grandfather, Karel van Lanschot, from an art dealer in Amsterdam in 1932. It was a very prominent Jewish art dealer by the name Jacques Goudstikker (1897-1940) and the painting had the cost of 1500 florins/Dutch guilder (Fig. 1). The paintings subject is a still-life, as it depicts inanimate subject matter, in this case fruits, oysters, cheese, bread, meat, butter and glasses on a table (Fig. front page).

The still-life genre painting was very popular in the Netherlands in the 16th and 17th century and was designed to depict the things belonging to everyday life. The still-life paintings were affordable for the middle class and a good way to decorate the walls in the house, and the objects in the paintings often acted as a symbol of the things they could not afford. The often depicted silver cups used for beer for instance, had the cost of about 30 guilders in the late 17th century, while a painting of a master in Haarlem could be acquired for about 10 guilders (Chong et al., 1999).



J. Goudstikker
Kunsthandel
Opgericht 1845
AMSTERDAM-C.

NOORD-HOLLAND 10 C

Ontvangen van den Weledelgeb. Heer
Karel van Lanschot, den Bosch
de somma van:
Een duizend vijfhonderd gulden
ter vereffening zijner rekening.

Amsterdam, 22 Febr. 1932

f 1.500.-

KUNSTHANDEL
J. GOUDSTIKKER N.V.
DIRECTEUR

Fig. 1. The receipt from the purchase of the painting from the art dealer Jacques Goudstikker, in Amsterdam in 1932 (Jettie van Lanschot, 2011).

The painting is not signed but it is, according to the owner of the painting, attributed to Pieter Claesz (c. 1597-1 January 1660). Pieter Claesz is considered one of the most important Dutch still-life painters of the 17th century. He was born in Berchem, near Antwerp but lived and worked in Haarlem between 1621 and 1660, a major Dutch art center that was home to many distinguished artists, among them several still-life painters, who benefited from the patronage of the town's wealthy citizenry. Pieter Claesz was a member first of the Antwerp Guild of St. Luke and later of the Haarlem Guild of St. Luke (http://www.nga.gov/press/exh/217/index.shtm, 26/3-2011).

2.1 Description of the painting

The painting is painted with oil paints on a rectangular wooden support, consisting of two planks of wood which has been glued together. The upper piece of wood measures 23,0 cm x 71,2 cm, while the bottom piece measures 29,8 cm x 71,2 cm. The total size is 52,8 cm x 71,2 cm (Fig. 2), with a varying thickness alongside the upper edge of 0,5 mm and the lower edge of 0,9 mm.

The two pieces of wood are in good condition and seems stabile, and there are no signs of microbiological deterioration like fungi- or pest infestation. The original gluing of the boards had failed and was re-glued during conservation treatment in 2004. Both vertical ends of the panel are beveled towards the center. Beveling of the edges of the panel where often done to make it easier to mount it in a frame, if the frame was e.g. made with a rabbet so the panel could be mounted easier with iron nails (Fig. 3). What is seen today is not the original mounting of the panel in the frame. The back of the planks are quite dark and it seems to have been added a layer of material from the back, possibly to prevent it from warping. The front of the painting is rather straight and flat, while the back shows obvious tool marks. The tool marks are uniform and regular, which could indicate the use of a saw (Fig. 4).

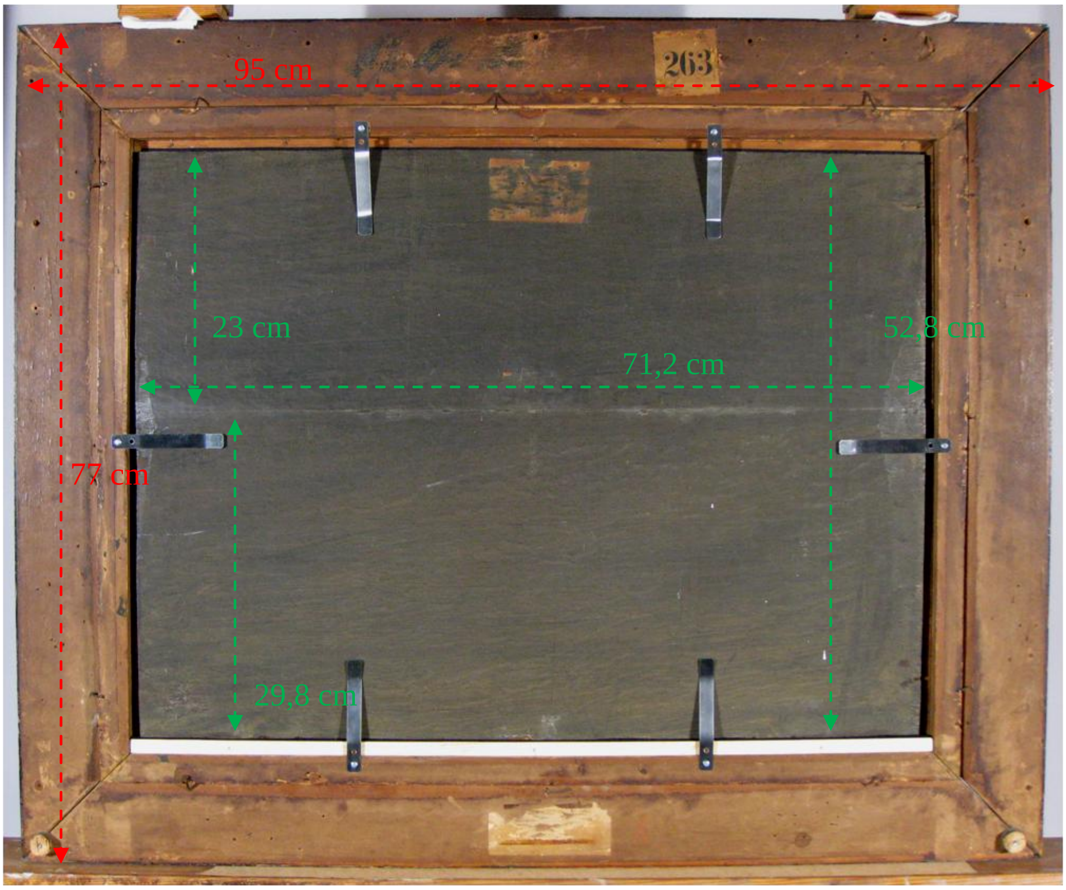


Fig. 2. The back of the panel painting and frame, with measurements applied.

Fig. 3. A beveled panel mounted in the rabbet of a frame and held with nails. (Wadum, 1998)

Fig. 4. Detail of the back of the planks of the painting, showing uniform and regular tool marks, indicating the use of a saw.

The owner of the painting informs that the picture frame was bought along with the painting in 1932. This is also made of wood and the front is painted with a glossy black paint. The inner edge of the frame consists of a thin golden wooden list. The outer edge of the frame measures 95 cm x 77 cm and the inner edge measures 52,2 cm x 69,2 cm. The back side of the frame is covered by brown paper, which has been glued on, leaving very little of the wood visible.

3. Species of wood, quality and preparation of panels for paintings

The use of wood as the support for paintings was gradually replaced with the use of canvas in Northern Europe during the 17th century. This was partly due to the growing format of the paintings as well as easing transportation (Villers, 1981). Most still-life paintings continued however to be painted on wood, since the format was often rather small compared to other genres in painting. The production of paintings was controlled by the guilds. The guild did not only comprise of painters, but many members of the various crafts related to art production, including panel makers, since the painter generally did not prepare the panel himself. Manuscripts and documentation show that quality control was introduced already in the Middle Ages. The panels were controlled by representatives of the guild and any irregularities would be reported to the head of the guild, and the panel maker would be punished accordingly. An example of this was the threat of a fine if the panel maker for instance used sapwood. The guild rules and relationships among the different crafts, varied from town to town, therefore a direct comparison is difficult, though a few general things can be identified.

The artist would often use wood native to their region. The German Renaissance artist, Albrect Dürer (1471-1528) for example, painted on poplar when he was in Venice and on oak when he was in the Netherlands and southern Germany (Wadum, 1998). Italian panel paintings from the earliest surviving examples until the 17th century, was almost always painted on poplar, mostly either the white poplar (*Populus alba* L.) or the black poplar (*Populus nigra* L.) (Bomford et al. 2002). In the Northern European countries the use of several species has been seen, among spruce (*Picea*), lime (*Tilia*), fir (*Abies*) and pine (*Pinus*), but in general oak (*Quercus*) was mostly favored as the support for paintings. However, the oak favored by the painters of the northern school, was not always of local origin. In recent years dendrocronological studies have traced the enormous exportation of oak from the Baltic region to the Hansa Towns, being shipped down to the Netherlands through the strait now dividing Denmark and Sweden, often from Köningsberg or Danzig (Gdansk) (Fig. 5) (Wadum, 1998). In the first half of of the 17th century the Netherlandish painters used Baltic oak wood, but the Second Swedish-Polish War (1655-60) caused a total breakdown of the Hansa trade. Thus Baltic timber is never found in panels made after 1650, oak planks from forests in Western Germany or the Netherlands were used instead (Klein, 1998).

The quality of an oak panel could be seen from its grain. If the medullary rays were visible this meant that the plank was radial cut and the quality therefore good. Also the density of the wood was important for the quality. According to Wadum (1998) the growth rings from before 1630-40 are often found to be narrower than those of oak tree available after this date. The guild rules emphasized that the wood used in the construction of the panels should be well seasoned to avoid mayor distortions in the panels after drying. Studies have shown that the seasoning period in the 16th and 17th centuries was between two to five years. Especially the Antwerp guild of St. Luke was very specific about these regulations of manufacture, before any painter was allowed to paint on the panel (Wadum, 1998). This is also confirmed in studies made at the University of Hamburg, where 200 panel paintings were examined. Panels that where signed and dated by the artist showed that rarely more than five years had passed before the execution of the painting (http://www.nnu.dk/dendro/dendroinfodk.htm 29/3-2011).

Fig. 5. Northern Europe around the year 1400, showing the extent of the HansaTowns. (http://en.wikipedia.org/wiki/Hanseatic_ League, 22/3-2011)

The saw which had been known in classical times but forgotten and rediscovered in the 14th century was mainly used for the splitting or cutting of the timber, and sometimes later, further treated with axes or scraping irons. A painting by Gillis Mostaert from 1610, shows woodworkers cutting trunks with different types of saws (Fig. 6). When two or more pieces of planks were glued together, heartwood was joined with heartwood and sapwood with sapwood, but the planks were usually joined in such a way, that the heartwood was on the outer edges (Wadum, 1998). When gluing the panels together, butterflies, keys or dowels could be applied for reinforcement and better enhancement, but most panels seems to have been simply butt joined (Campbell, 1997).

Fig. 6. Gillis Mostaert: A Landscape with Christ Healing the Blind Man. Ca.1610. Oil on panel, 35,5 x 53 cm. Showing woodworkers cutting tree trunks with different types of saws. (Wadum, 1998)

4. Dendrochronology

Dendrochronology, also known as tree ring dating, is a scientific method of dating wood, based on the analysis of the patterns of tree growth rings. Dendrochronology can date the time of which growth rings were formed, in many types of wood, to the exact calendar year. Dendrochronology relies on the fact that trees grow more in seasons in which the weather conditions are ideal and less when they are poor. Within a given geographic area every tree of the same species will respond identically to these conditions. The measure of growth is reflected in the tree's rings. By collating the growth rings from living trees and historical timber it is possible to establish curves for of a specific species and area covering several hundred years, and sometimes up to several thousand years back in history. These curves are called “master chronologies”. To perform a dendrochronological dating it is provided that a well worked master chronology from the area of origin has been prepared.

The possibility for obtaining the precise data, for the time of the felling of a tree, depends whether the bark or sapwood is present in the sample. The sapwood is right before the bark and it contains the latest created growth rings. If the bark and sapwood are present it is possibly to determine a very precise time for when the tree was alive and growing, as well as the season of the felling. If the sapwood is missing, it is possible to calculate and make an estimate of the felling time. The amount varies but several statistics are obtained of how many growth rings are in the sapwood depending on the age of the tree and the geographic area. According to the statistics, mature oak trees for instance (100-200 growth rings), which has been growing in Ireland and England, in average holds about 30 growth rings in the sapwood, Western European oaks holds 25, while the number decreases when moving further East towards Poland, where the trees contains about 13-19 rings in the sapwood. If not only the sapwood is missing but also some of the heartwood, it can be even harder to determine the felling time, in this case a date for the earliest possible felling time is given with the terminology *Terminus post quem.* (http://www.nnu.dk/dendro/dendroinfodk.htm 29/3-2011)

It is important to mention that dendrochronology is not a universal method of dating wood. It is only applicable to the places on earth where trees produce clearly defined yearly growth rings. Also it is limited to species which can deliver enough material to create a master chronology.

5. Method

The methods for the analyses performed in this project, is based on a visual analysis both macroscopically and microscopically. This is the foundation for identifying the species of wood, the construction of the panel, and for making counts of the growth rings for performing dendrochronology. The method for the process of identifying wood species in the panel and frame of the painting, as well as dendrochronology, is described below.

5.1 Method for identification of wood species used in panel and frame

The process of identifying wood, simply stated, involves the visual recognition of anatomical features that singly or in combination are known to be unique to a particular species. Visual or macroscopic features are the natural starting point for identification, but for a final determination or verification of the macroscopic features, the best result comes from razor-cut thin sections of wood tissue examined with a microscope. To obtain the best possible determination it is necessary to view samples from the three sections of the wood; the transverse (cross) section, the radial section and the tangential section (Fig. 7.)

In order to establish the species of the wood used for the painting and the decorative frame both a macroscopic and a microscopic analysis was performed. To make samples for microscopic identification it was necessary first to identify the different surfaces on the panel and on the frame. The transverse surface was found alongside the vertical edges on the left and right side of the panel, the radial surface on the back of the panel, and the tangential surface on the top and bottom edge of the panel. A small area on the back in the proper bottom left corner of the panel, was cleaned of the applied material to make a sample of the radial surface. In the same area samples from the transverse and tangential surface was taken as well, see figure 8.

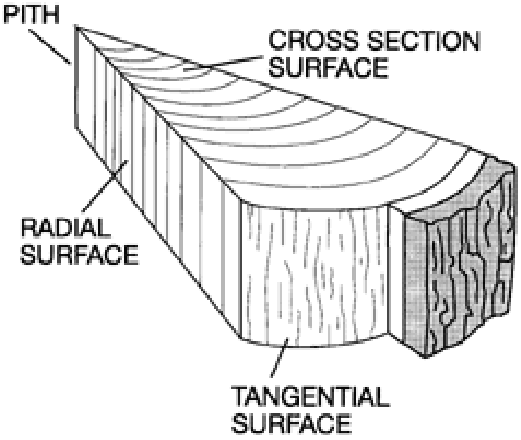


Fig. 7. The placement of the three different surfaces on a wood sample. (Bowyer et.al., 2003)

On the frame the samples was taken from the outer part of the frame on the proper right side, in the upper corner. It was not possible to make a macroscopic examination since the front is covered with black paint and the back is covered with brown paper, leaving only very little part of the wood visible. Despite this, it was possible to take samples from all surfaces. The tangential surface was found on the back side, the radial surface on the part towards the inside. The transverse surface was found in the miter joint, and the sample could be taken because of a small gap (Fig. 9).

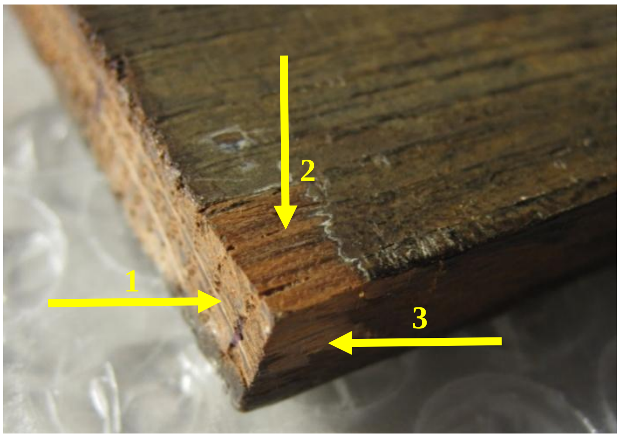


Fig. 8. Bottom proper left corner of the panel, with arrows indicating where the cuts has been made. The cuts are identified as: 1) cross section; 2) radial section; 3) tangential section.

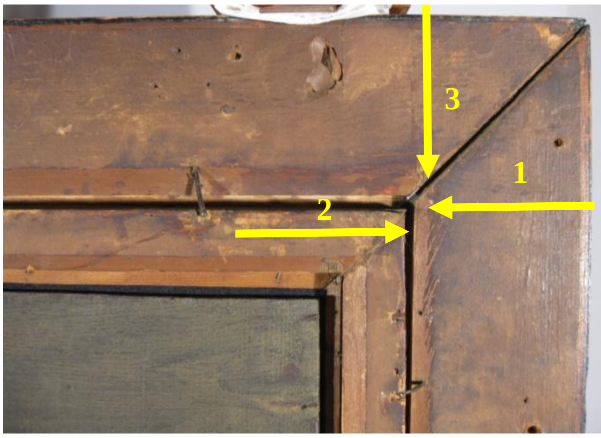


Fig. 9. Top proper right corner of the frame, with arrows indicating where the cuts has been made. The cuts are identified as: 1) tangential section; 2) radial section; 3) cross section.

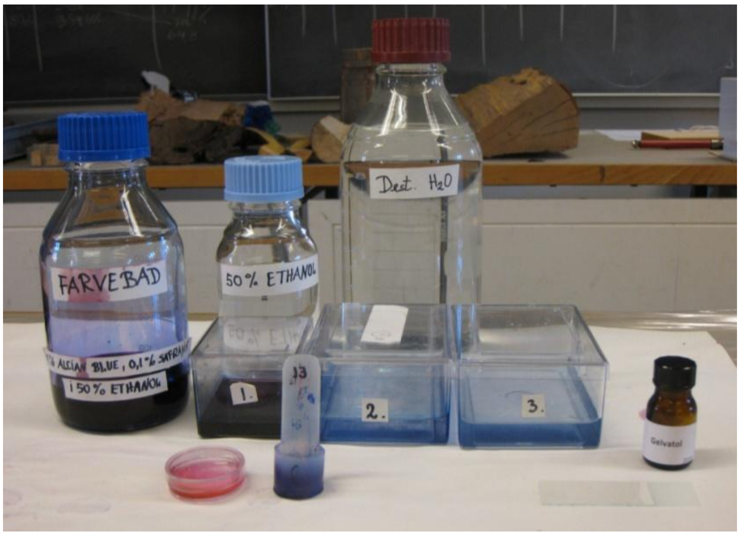
The wood samples were cut off in very tiny thin slices with a razor blade. To better be able to see the features in the microscope the samples was stained by the following method (Fig. 10):

1. Three containers were prepared. The first container with 50 ml. color solution (0,1% alcian blue, 0,1% safranin in 50% ethanol), the two others each with 100 ml. of distilled water.

2. The wooden samples were put into in a dye-wire-basket, which was placed in the container holding the dye bath, for about 10-15 minutes.

3. To rinse the samples, the basket was then placed in the second container for 2 minutes, and after this, for further rinsing, in the third container for 2 minutes.

After staining the samples were mounted on glass slides. Some drops of mounting fluid (Gelvatol) were put on the glass slide. The samples was taken from the basket with a set of tweezers and placed in the mounting fluid. A cover slip was gently placed on top (Fig. 11). For determining the species a key for identification was used, primarily based on microscopic features. In this case the key developed by Mork, Dahl-Møller and Rastad, which has been handed out during the course.



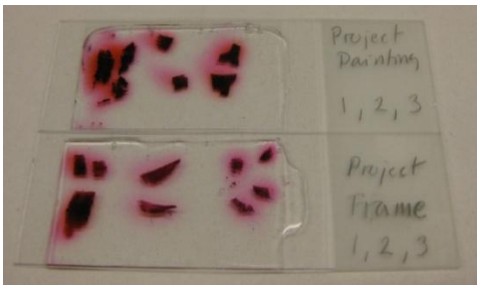


Fig. 11. The samples mounted on a glass slide with Gelvatol and a cover slip. The numbers refers to the different sections as indicated in figure 8 and 9.

Fig.10. The materials used for staining and mounting of wooden samples. Dye, ethanol, distilled water, three containers for dye and rinsing, a petri-dish containing ethanol, Gelvatol mounting fluid and a glass slide.

5.2 Method of dendrochronology

The method of dendrochronoly is used in order to hopefully date the wood, and possibly help authenticate the painting and investigate the possibility of the painting being executed by the still-life painter Pieter Claesz. The examination was only performed on the panel, not on the frame. The dendrochronological examination of the panel was performed at the laboratory of dendrochronology at the National Museum of Denmark (NNU).

A dendrochronological examination is performed on the horizontal cross section, or transverse surface, of a wooden sample. A path for measuring is shaped by a razor blade knife, made especially for this purpose (Fig. 12 and 13). This is done to get a clear visual sight of the growth rings, for comparison see figure 14 and 15 showing the transverse surface on the painting before and after the removal of the top layer of wood with the razor blade knife.

Fig. 12. The razor blade knife, utilized to make a path for measuring, in the wood sample.

Fig. 13. A path for measuring made with the razor blade knife on a random sample.

Fig. 14. The proper right edge of the panel which has not been cut. The rays are quite clear, but a precise distinction between the different growth rings is difficult.

Fig.15. The proper left edge of the panel after the removal of the top layer of wood, to be able to clearly view the growth rings. Marks indicate every tenth growth ring.

For the examination, a microscope with an enhancement of about 10-40x, along with a machine for measuring data is used. The sizes of the growth rings of the sample are measured, and this is normally done twice. Curves, from each of the lines of measurements, are made to gain a better visual control. The two curves are then added together to make one curve, based on an average, which best represents the sample.

Fig.16. The panel mounted under the microscope. In lack of a string a scarf was used to restrain the panel from falling to the ground.

The proper left vertical edge of the painting was prepared with the razor blade knife, by cutting off the top layer of wood to more clearly be able to see the growth rings. It was done alongside the entire edge, but without harming the paint layer on the front. The painting was mounted under the microscope for measuring (Fig. 16). The preparation of the edge of the painting with the knife was done partly before and after the mounting, since it is sometimes easier to see the result of the cutting under the microscope (Fig. 17). Looking in the microscope, pen marks where added for each tenth growth ring (Fig. 15). This is to avoid errors between the numbers of growth rings, when measuring. With the aid of a computer and a machine for capturing data, each growth ring was measured while looking in the microscope (Fig. 18). The line of measurement was performed twice to reduce errors and making a better statistic curve.

Fig.17. Cutting of the edge of the panel with the razor blade knife under the microscope.

Fig.18. Counting of the growth rings while looking in the microscope

The computer program used for capturing the data is called DENDRO. The painting was recorded into the system under the name “A9048 Pieter Claesz”. The measurements of the two planks were recorded into the system under the filename 0261001a/0261001b for the lower board and 0261002a/0261002b for the upper board. When making filenames a number of 8 digits or signs are used. Here 0 is an indication of unknown provenience, 261 is the file number while 001/002 is the number of samples, here two planks, while a/b represents the first and second line of measurements. After the two curves are added together a/b is replaced by the number “9”. The filename for the final curve of the lower board is 02610019 and 02610029 for the upper board.

The two final curves were then entered into the system as chronologies, and through statistic calculations in the program a thorough comparison to the master chronologies were performed. The basis for determining how well the sample curves fit the master chronology is determined by the statistically calculated t-values.[1] The t-value between a chronology of a sample and a master chronology should be about 3,5 for a probability of 99,99%, but preferably above 5 for a 100% probability, to be able to make any conclusions towards the dating and geographic placement of a sample.

6. Results

The results of the different analyses will be explained below. First the results of the identification of the wood species, then the construction of the panel and lastly the results of the dendrochronological examination.

6.1 Identification of wood species in panel and frame

The panel could already macroscopically with great certainty be identified as oak. This was due to the clearly ring-porous structure in the transverse surface and large medullary rays seen in the radial cut (Fig. 4). This was confirmed by the samples viewed under the microscope when following the

[1] The mathematics and theory behind statistics and t-values will not be explained in this report, information about the subject can e.g. be found in: Baillie, M.G.L. (1982) *Tree-Ring Dating and Archaeology*. Croom-Helm, London.

key for microscopic identification. In the transverse section the ring-porous structure is visible with very large vessels in the early wood, with a rather abrupt change in size to smaller vessels, with a tendency of arrangement in straight radial lines in the late wood (Fig.19). In the tangential section large multi-seriate rays can be seen along with smaller uniseriate rays (Fig. 20). All of which characterizes the species as oak (*Quercus*). The genus Quercus comprises of 28 species, but since it is rather difficult to distinguish the species from one another, efforts to determine the specific species used in the panel was not done in relation to this project (Schweingruber, 1990)

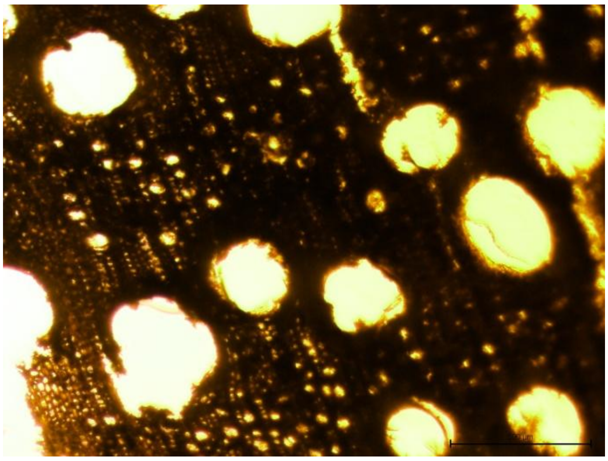


Fig. 19. Transverse section of the panel, with large vessels in a ring-porous structure with smaller vessels with a tendency of radial lines in the latewood .

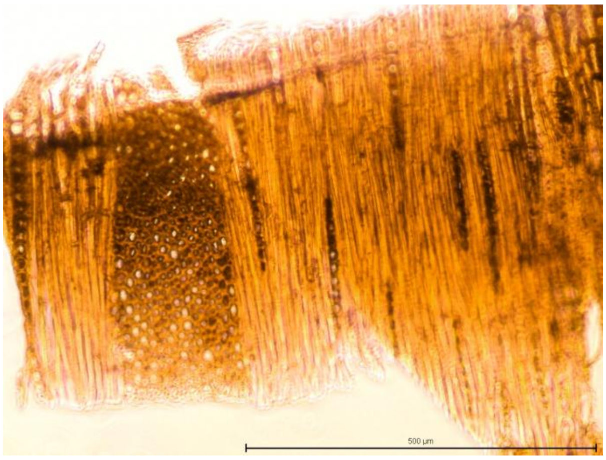


Fig. 20. Tangential section of the panel, with large multi-seriate rays along with smaller uniseriate rays.

The samples from the frame was also investigated under the microscope and found to be alder (*Alnus*). The transverse section shows a diffuse-porous structure with relatively uniform sized vessels and even in distribution (Fig. 21.). In the tangential section the rays appear uniseriate (Fig. 22) and in the radial section scalariform perforation plates are visible (Fig. 23.) Other species with similar characteristics are birch (*Betula*) and hasel (*Corylus*) but since the scalariform perforation plates in hasel only make up to 10 bars, this species could be excluded since the sample shows scalariform plates with more than 10 bars. Birch could also be exluded because of the presence of fake rays seen in the tangential section (Fig. 24).

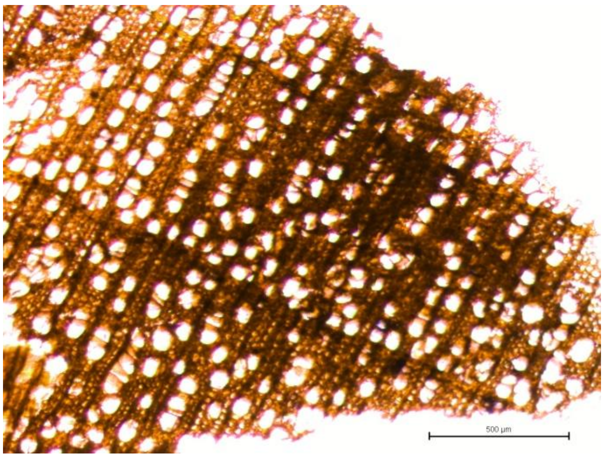


Fig.21. Transverse section showing diffuse-porous vessels uniform in size and even in distribution.

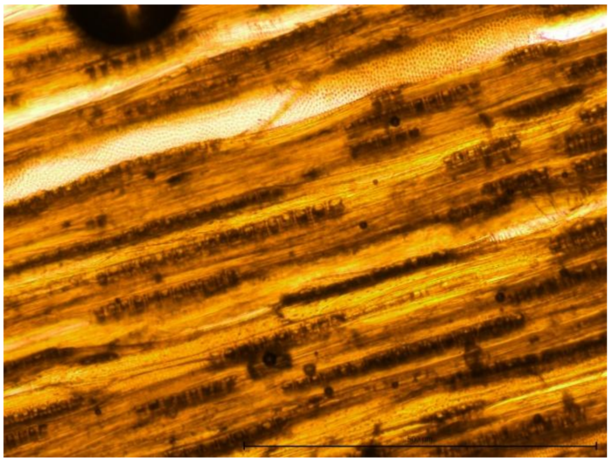


Fig.22. Tangential section showing uniseriate rays.

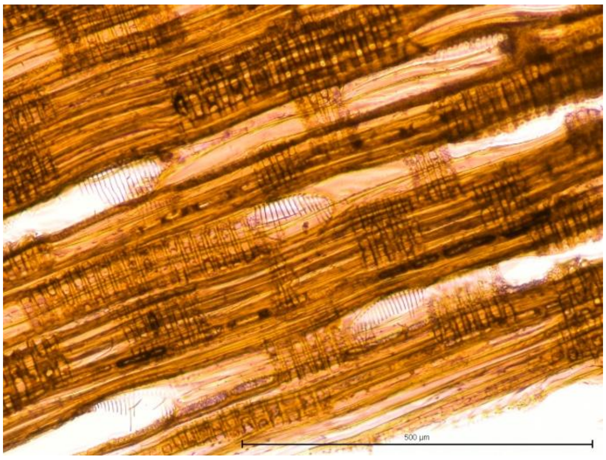


Fig.23. Radial section showing scalariform perforation plates with more than 10 bars.

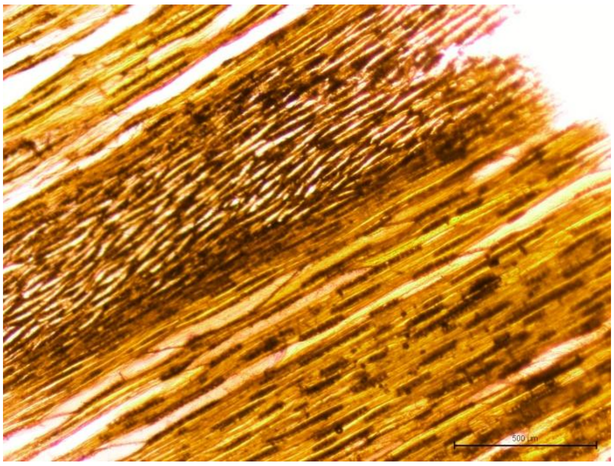
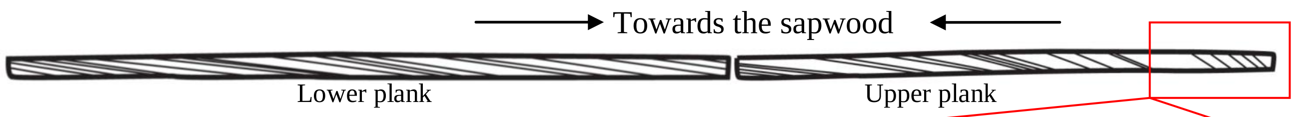


Fig.24. Tangential section showing false rays.

6.2 Construction of the panel

Through visual analysis it was possible to determine the construction of the panel and make a suggestion from where the planks were cut from the tree. This became easier after the edge of the panel had been prepared for the dendrochronological examination, since the growth rings became more clearly visible. It is radial cut planks, the bottom plank seem to have been cut in the most radial direction, as the growth rings are more or less at right angles to the broad face. It is not possible however to see how close to the pith the plank has been cut. The top plank is cut out just off the center, since the end of the plank shows more rounded growth rings as the radius get smaller towards the pith (Fig.25). The two planks making out the panel was glued together as described above, in the direction of sapwood against sapwood and with the heartwood on the outer edges, though there are no actual sapwood on the panel. Figure 25 shows the construction of the panel with a drawing of the two planks as they look in the transverse surface when seen from the proper left side. The lines drawn are the medullary rays, and are not to be confused as the growth rings. It has not been possible to find a source documenting the most common way of sawing logs in the 16^{th} and 17^{th} century, but quarter sawn oak was not uncommon. Figure 26 gives a suggestion of where the planks could have been cut from the log.



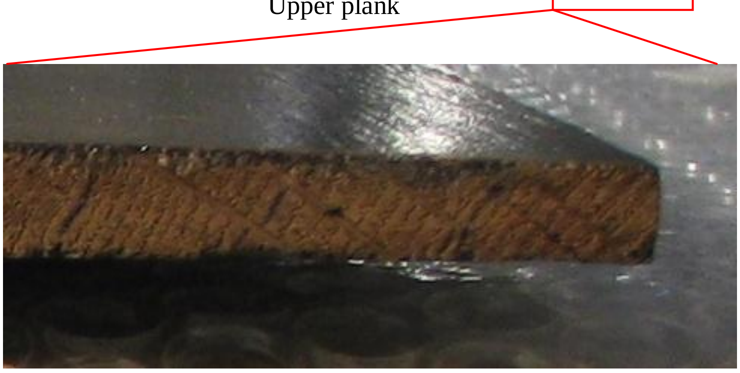


Fig. 25. The construction of the panel with a drawing of the two planks as they look in the transverse surface seen from the proper left side. The lines drawn are the medullary rays. A section of the upper plank is shown as a photo, where the change in radius of the growth rings can be seen towards the pith.

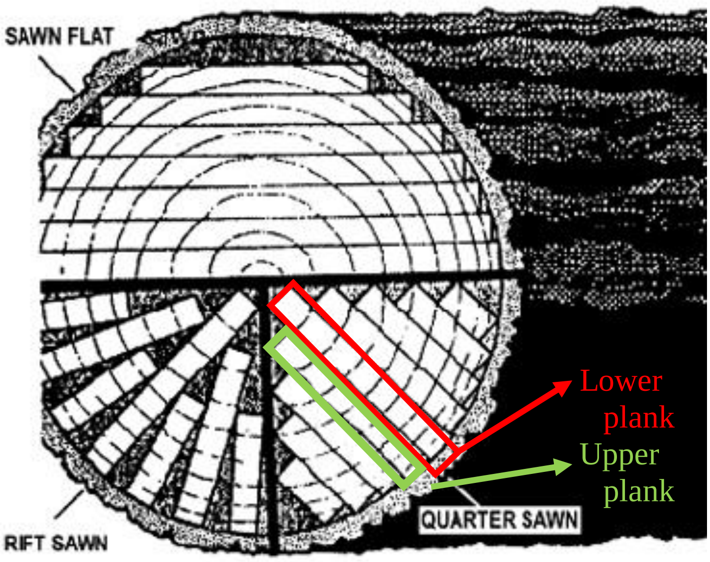


Fig. 26. Different ways of sawing a tree log, with a suggestion from where the two planks of the panel have been cut.

6.3 Dendrochronology and dating

That the species of wood of the panel appeared to be oak was favorable in relation to the dendrochronological examination, since oak is one of the species where several master chronologies from different geographic areas has been established. The calculated chronologies of the planks were compared to 320 master chronologies from Northern Europe in the database.

The lower plank, given the filename 02610019 had 150 growth rings. The upper plank, given the filename 02610029, had 178 growth rings, though the actual size of the plank is shorter than the lower plank, which means it has been growing slower and has a lower density.

The examination showed that the trees from which the two planks have been made, are most likely not from the same geographic area, since there are no cross dating of the curves of the two planks. The upper plank, with 178 growth rings gave a high t-value of 7.16 to a master chronology from Southern Germany, dating the last formed growth ring on the plank to 1618. After the addition of the missing growth rings of the sapwood, it can be calculated that the tree from which the plank is from, has a *terminus post quem* of 1638 A.D.

The other plank appeared more troublesome, and did not give any convincing results in the normal master chronologies. Instead it was compared to master chronologies made from 200 oak panel paintings with unknown provenience in Northern Europe, but which has been signed and dated by the artist. This gave good results with t-values between 4.07 and 4.94, dating the last formed growth ring on the plank to 1634. After the addition of the missing growth rings of the sapwood, it can be calculated that the tree from which the plank is from, has a *terminus post quem* of 1654 A.D. The results are summed up in table 1 and figure 27. The full report from the laboratory of dendrochronology can be viewed as Annex 1.

Table 1. Results of the dendrochronological examinations.

A9048 Pieter Claesz - maleri - Katalog								
Unders nr.	Beskrivelse	År	Marv	Splint	Slutring	Synkron position	Datering/fældning	Bem.
02610019	nedre bræt	150	?	nej	H1	1485-1634	efter ca. 1654	
02610029	øvre bræt	178	5-10 cm	nej	H1	1441-1618	efter ca. 1638	
Tegnforklaring: B - bark. W - waldkante (barkring). vf - vinterfældning. sf - sommerfældning. Hx - Heartwood (kerneved) x = antal. Sx - Sapwood (splintved) x = antal. Hx og Sx angiver årringe, som ikke er inkluderet i rubrikkerne År og Splint. H/S angiver Heartwood/Sapwood grænse.								

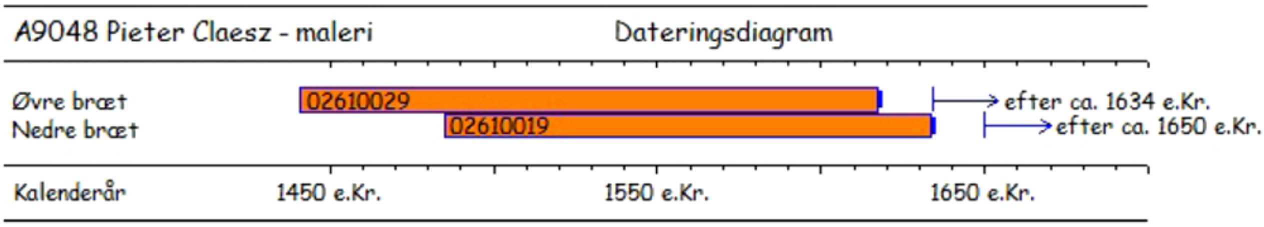


Fig. 27. Diagram for dating of the planks.

7. Discussion

The identification of the species of wood used in the panel as oak, is in good relation to the species which was most commonly used for panels in the Northern European countries in the 17th century. No relation has been investigated of the species of wood used for the frame. Several other features of the panel are also in good relation to the techniques and constructions for making panel paintings in that era, as described by Jørgen Wadum (1998). This is both in relation to the cut of the grain in the radial direction, stated as being considered the best quality of a panel, and the fact that no sapwood is present, since this in some instances would result in a fine according to guild rules. One of the reasons for not being allowed to use sapwood is probably due to the fact that the sapwood still contains living cells, while the heartwood only holds dead cells and is therefore more resistant to decay and insects. Panels and frames are often seen with signs of attack from the common furniture beetle (Anobium punctatum) which mainly attacks seasoned sapwood leaving small round exit holes of 1 to 1.5 mm in diameter.

Since the planks were glued together, it was not possible to see whether they were anything but butt joined, which was the most common. It was possible to determine though, that the planks had been joined in the direction of sapwood against sapwood. The importance of joining sapwood against sapwood, or heartwood against hardwood is because the two directions tend to shrink differently, and joining the same directions can help make a less visible joint as shown in figure 28.

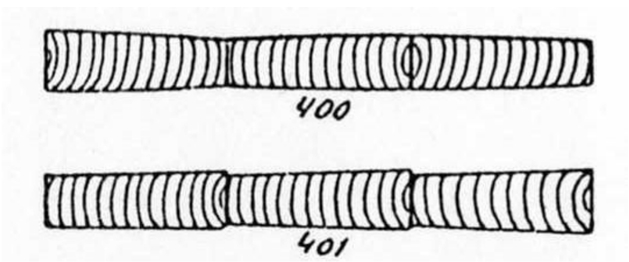


Fig.28. The difference between joining a panel sapwood against sapwood or heartwood against heartwood (400), compared to sapwood against heartwood (401), the latter will make the joint more visible. (Jacobsen, 1933)

The marks on the back of the panel, indicates the use of a saw for cutting the panel. The regularity and uniformity of the marks could point towards some kind of mechanical saw, used either in a water or wind driven sawmill, since a hand powered saw, often results in less uniform marks, as it is difficult pulling the saw equally at each draw. A copper engraving from the book, *The various and ingenious machines* by Agostino Ramelli from 1588, shows the system of a water powered sawmill, and it is possible that the panels were cut using such a system (Fig.29).

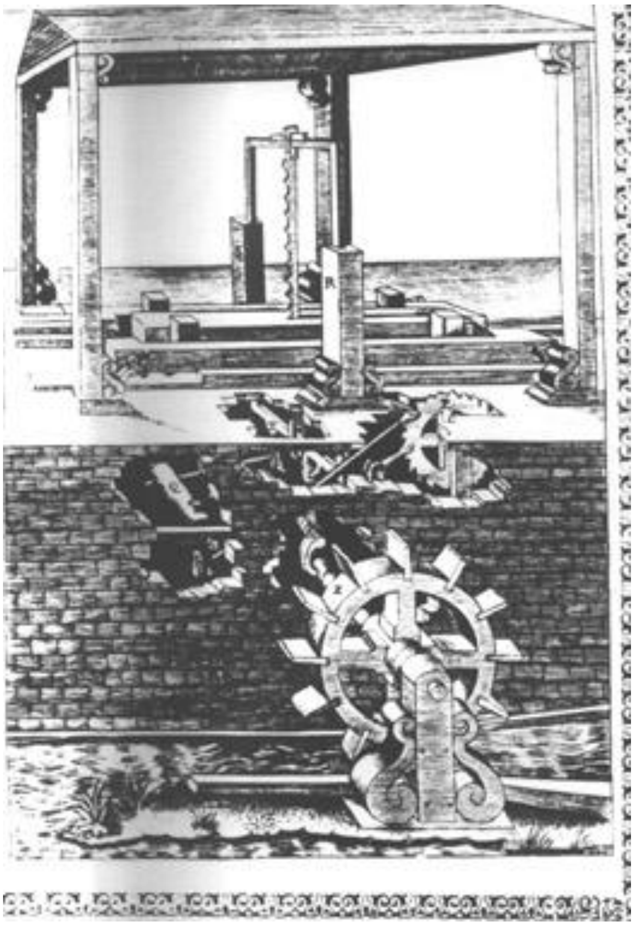


Fig. 29. Copper engraving from Agostino Ramelli's *The various and ingenious machines,*1588. (http://sendlhofer.members.cablelink.at/geschichte/eschichte.htm, 30/3-2011)

Also the density of the wood was important for the quality. According to Wadum (1998) the growth rings from before 1630-40 are often found to be narrower than those of oak tree available after this date. This is most likely due to the changes in trade routes after the end of the Thirty Year War (1618-1648) and the Second Swedish-Polish War, where timber seem to stop coming from the Baltic region. The upper board of the panel had rather narrow growth rings but appeared to be from Southern Germany and not from the Baltic region, which fits well with a felling date after 1650.
It could be concluded that the two planks did not come from the same tree or area. That is was not possible to establish the geographic origin of the lower board, could just mean that a master chronology of the specific area has not yet been established.

It is not unlikely that the panel maker has bought and received panels from different regions, and it is not even safe to say whether the panel maker knew exactly where the wood came from. The painter Karel van Mander (1548-1606) for instance knew that oak was being imported from the North Sea, believing it came from Norway, though it came from the Baltic.

When looking at the dating of the panel, the planks have a *terminus post quem* of about twenty years apart. Normally the timber where only seasoned for 2-5 years, and it seem like a long time for the upper panel to be stored. It was not possible to see how close to the pith the planks were cut since there was no sapwood on either plank. The upper board has more curved growth rings in direction of the pith indicating that it could have been cut rather close to the pith. If the other, lower plank was cut further from the pith, it could allow the two trees to actually have a similar felling time, but off course this can only be speculated and not concluded.

The lower plank is dated with a *terminus post quem* of 1654 A.D. With a seasoning time of 2-5 years the painting could have been painted after 1656. The painter Pieter Claesz died in 1660 so it is possible he could have painted the painting within the last years of his life.

8. Conclusion

Though canvas had become the preferred support for paintings in the 16th and 17th century, paintings of the still-life genre seem to continually have been painted on wooden panels. The preparation for panel paintings in Northern Europe was done under strict rules of the guilds. This means several general features can be characterized. The preferred species for the panel was oak, and the best quality was planks which had been radial cut. The panel maker was not allowed to use sapwood, probably because it is less resistant to decay and insects compared to heartwood. When the panels were joined to make larger panels, the planks were joined sapwood against sapwood and heartwood against heartwood, to make the joint the least visible if shrinkage should occur.

For the aims of the project a Netherlandish panel painting dating presumably from the first half of the 17th century was investigated. Several features coincided with the practice of preparing of panels controlled by the guilds. The wood species appeared to be oak (*Quercus*), which was identified both through a macroscopic and a microscopic analysis, by following a key for identification. It was joined sapwood against sapwood from two radial cut planks. Tool marks on the back of the panel indicated the use of a saw for cutting out the planks, and because of their uniformity and regularity this was probably done by a wind- or water powered sawmill. The wood of the picture frame was also identified, but as the species of alder (*Alnus*).

A dendrochronological examination, which is dating of wood based on the size and relation of the growt rings, was performed on the two planks of the panel. There were no cross dating between the two established curves, which means that the two planks was not from the same tree and originated from different geographic areas. It was possible to determine that the upper plank comes from Southern Germany and has an earliest possible felling date or *terminus post quem*, of 1638 A.D. The lower plank could not be placed geographically, except that it coincided with curves from dendrochronological examinations performed from signed and dated paintings from Northern Europe and was determined to have a *terminus post quem* of 1654 A.D. It is possible that analysis in the future could give a different or more precise geographical result as the amount of master chronologies increases continuously.

The painting was bought in Amsterdam in 1932, it is not signed but it is attributed to the Dutch painter Pieter Claesz who died in 1660. With a seasoning time of the wood between 2-5 years it is possible the painting could have been executed by Pieter Claesz during the last years of his life, though this by no means here can be certified. This would demand thorough investigation of materials and painting techniques between the still-life painting and a signed painting which, with certainty had been painted by Pieter Claesz. The attribution was probably only performed by a connoisseur, and they have often been seen to be wrong.

Both the identification of wood species and the dendrochronoloical examination turned out successful and convincing. Both are methods which will surely be used for the future, while having to deal with artifacts and paintings made of- or with parts of wood, either in relation to conservation treatment or in scientific investigations.

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Jettie van Lanschot, owner of the still life painting, and teacher and conservator at the Royal Danish Academy of Fine Arts, School of Conservation.

Niels Bonde and Orla Hylleberg Eriksen at the laboratory of dendrochronology at the National Museum of Denmark.

10. List of Annex

Annex 1. Report from the laboratory of dendrochronology at the National Museum of Denmark
Annex 2. MSDS of Gelvatol mounting fluid.